Disparities in the treatment and outcomes of vascular disease in Hispanic patients

Nicholas J. Morrissey, MD,[a] Jeannine Giacovelli, MD,[a,b] Natalia Egorova, MPH, PhD,[b] Annetine Gelijns, PhD,[b] Alan Moskowitz, MD,[b] James McKinsey, MD,[a] Kenneth Craig Kent, MD,[a] and **Giampaolo Greco, PhD,[b]** *New York, NY*

Background: **The Hispanic population represents the fastest growing minority in the United States. As the population grows and ages, the vascular surgery community will be providing increasing amounts of care to this diverse group. To appropriately administer preventive and therapeutic care, it is important to understand the incidence, risk factors, and natural history of vascular disease in Hispanic patients.**

Methods: **We analyzed hospital discharge databases from New York and Florida to determine the rate of lower extremity revascularization (LER), carotid revascularization (CR), and abdominal aortic aneurysm (AAA) repair in Hispanics relative to the general population. The rates of common comorbidities, the indications for the procedures, and outcomes during the same hospitalization as the index procedure were determined. Multivariate logistic regression analysis was used to determine the differences between Hispanics and white non-Hispanics with respect to rate of procedure, symptoms at presentation, and outcome after procedure. Demographic variables and length of stay were also analyzed.**

Results. **The rate of LER, CR, and AAA repair was significantly lower in Hispanic patients than in white non-Hispanics. Despite this lower rate of intervention, Hispanics were significantly more likely than whites to present with limb-threatening lower extremity ischemia (odds ratio [OR], 2.09; 95% confidence interval [CI], 1.91 to 2.29), symptomatic carotid artery disease (OR, 1.57; 95% CI, 1.4 to 1.75), and ruptured AAA (OR, 1.26; 95% CI, 1.04-1.52) than white non-Hispanics These differences were maintained after controlling for the presence of diabetes mellitus and other comorbidities. Hispanic patients had higher rates of amputation during the same hospitalization after LER (6.2% vs 3.4%, $P < .0001$) and higher mortality after elective AAA repair (5% vs 3.4%, $P = .0032$). Length of stay after LER, CR, and AAA repair was longer for Hispanic patients than white non-Hispanics.**

Conclusion: **Significant disparities in the rate of utilization of three common vascular surgical procedures exist between Hispanic patients and the general population. In addition, Hispanics appear to present with more advanced disease and have worse outcomes in some cases. Reasons for these disparities must be determined to improve these results in the fastest growing segment of our society. (J Vasc Surg 2007;46:971-8.)**

Hispanics are the fastest growing minority in the United States (US), and are estimated to comprise one-quarter of the total US population by 2050.[1,2] Numerous public health studies have demonstrated the existence of substantial health disparities in this population, including higher rates of breast arterial calcification, diabetes mellitus, and renal failure, as well as an increased risk of death from prostate cancer and liver disease.[3-8] Previous research has shown that distinctive biologic, socioeconomic, and cultural factors may have an impact on the treatment and outcomes of vascular disease.[2,9-11] Therefore, understanding the health issues that uniquely impact Hispanics is essential to provide the appropriate combination of preventive, diagnostic, and therapeutic modalities to these patients.

From the Division of Vascular Surgery, New York Presbyterian Hospital, Columbia College of Physicians and Surgeons, Weill Medical College of Cornell University[a]; and the International Center for Health Outcomes and Innovation Research, Columbia University Health Sciences.[b]

Competition of interest: none.

Reprint requests: Nicholas J. Morrissey, MD, Division of Vascular Surgery, New York Presbyterian Hospital, Columbia University College of Physicians and Surgeons, Weill Cornell Medical College, 161 Ft Washington Ave, Ste 639, New York, NY 10032 (e-mail: njm2106@columbia.edu).

0741-5214/$32.00

doi:10.1016/j.jvs.2007.07.021

Despite the well-documented rising prevalence in Hispanics of risk factors for vascular disease, such as diabetes and smoking, studies that focus on treatment and outcomes of vascular disease in this population are lacking. In this study, we aimed to determine, through large data set analysis, if differences exist between Hispanics and the general population with respect to the rate of treatment and clinical manifestations of common vascular diseases.

METHODS

Data sources. Publicly available hospital discharge data bases obtained from New York State Health Department, the Statewide Planning and Research Cooperative System (SPARCS),[12] and the Florida state Agency for Healthcare Administration,[13] years 2000-2004, were used in the study. These are populous states with a substantial presence of Hispanics. State administrative databases contain clinical and demographic information, including ethnicity, associated with each hospital discharge.

Patient population. Patients were selected using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) procedure and diagnoses codes, as described earlier.[14,15] Treatment groups were identified by matching all relevant procedure codes

Table I. List of International Classification of Diseases, 9th revision, Clinical Modification codes for comorbidities and postoperative complications

Comorbidities	*ICD9-CM code*	*Code description*
Diabetes	250	Diabetes mellitus
Hypertension	401	Essential hypertension
	402	Hypertensive heart disease
	403	Hypertensive renal disease
	404	Hypertensive heart and renal disease
	405	Secondary hypertension
Emphysema	490	Bronchitis, not specified as acute or chronic
	491	Chronic bronchitis
	492	Emphysema
	493	Asthma
	494	Bronchiectasis
	496	Chronic airway obstruction, not elsewhere classified
Coronary	413	Angina pectoris
	414	Other forms of chronic ischemic heart disease
	412	Old myocardial infarction
	429.2	Cardiovascular disease, unspecified
Peripheral	443.9	Peripheral vascular disease, unspecified
	440	Atherosclerosis
Renal	585	Chronic renal failure
	403	Hypertensive renal disease
	582	Chronic glomerulonephritis with unspecified pathologic lesion in kidney
Cerebral	434	Occlusion of cerebral arteries
	433	Occlusion and stenosis of precerebral arteries
	437	Other and ill-defined cerebrovascular disease
	438	Late effect of cerebrovascular disease
Lipids	272.0	Disorder of lipoid metabolism. Pure hypercholesterolemia
Hypotension	458.2	Hypotension. Iatrogenic hypotension
	458.8	Other specified hypotension
	458.9	Hypotension, unspecified

ICD-9CM, International Classification of Diseases, 9th revision, Clinical Modification.

with the primary and secondary diagnosis codes. Four code groups were analyzed: carotid revascularizations (CR), elective and ruptured abdominal aortic aneurysm (AAA) repair, lower extremity revascularizations (LER), and lower limb amputation. Patients undergoing AAA repair were categorized as 441.4 (unruptured) or 441.3 (unruptured). Patients who underwent carotid procedures were divided into symptomatic and asymptomatic groups:

- Symptomatic patients were those who presented with the following diagnoses (primary or any secondary positions): 433.11 (occlusion and stenosis of carotid artery with cerebral infarction), 433.31 (occlusion and stenosis of multiple and bilateral arteries with cerebral infarction), 435.9 (unspecified transient cerebral ischemia), 362.3 (retinal vascular occlusion), and 362.84 (retinal ischemia).
- Asymptomatic patients were those who presented with the diagnoses in the primary or any secondary positions of 433.10 and 433.30 (occlusion and stenosis of carotid and multiple and bilateral arteries without mention of cerebral infarction, respectively). If symptomatic and asymptomatic diagnoses were present in the same discharge summary, patients were included in the symptomatic group.

Patients who underwent LER with diagnoses of rest pain (440.22), ulceration (440.23 or 707.1), and gangrene (440.24 or 785.4) were included in the limb-threatening conditions group and were compared with patients who had diagnoses of claudication (440.21). If LER and major amputation were performed during the same hospitalization, these cases were considered as failed LER.

We assessed the following comorbidities (primary and all secondary diagnosis): diabetes, hypertension, emphysema, coronary disease, peripheral vascular disease, renal disease, cerebrovascular disease, and lipid metabolism disorder. Complications included (primary and all secondary diagnosis) cardiac, postoperative stroke, respiratory complications, bleeding, infection, shock, acute renal failure, and mesenteric infarction. Table I outlines the codes used to determine comorbidities and complications. A list of ICD9 diagnosis codes for comorbidities and complications is provided in our earlier publications.[14,15]

Standardization. The risk of developing vascular diseases and consequently undergoing a vascular procedure varies across the age groups. We used direct adjustment procedures to account for age and gender differences among Hispanics and white non-Hispanics

Table II. Comorbid conditions*

	LER			*CR*			*AAA*		
Condition	*WnH (%)*	*H (%)*	P	*WnH (%)*	*H (%)*	P	*WnH (%)*	*H (%)*	P
Diabetes	37.4	60.3	<.0001	25.6	41.7	<.0001	12.0	17.4	<.0001
Hypertension	62.3	66.2	<.0001	71.0	77.6	<.0001	61.7	68.5	<.0001
Renal	8.8	14.8	<.0001	2.1	3.5	<.0001	4.0	6.0	.0027
Coronary	42.9	39.1	<.0001	42.8	45.7	.0011	44.3	42.5	.3061
Emphysema	23.1	16.4	<.0001	17.7	13.8	<.0001	33.7	31.8	.2460
Cerebral	6.7	5.9	.0358	99.9	99.8	.6026	3.7	2.5	.0746
Lipids	11.9	10.3	.0003	19.3	17.9	.0623	15.4	14.0	.2677

LER, Lower extremity revascularization; *CR,* carotid revascularization; *AAA,* elective abdominal aortic aneurysm; *WnH,* white non-Hispanic; *H,* Hispanic.
*See Table III for number of observations.

(WnHs) in the usage of vascular procedures over time and to ensure a proper comparison.[16] Age and gender distribution by race for New York and Florida populations were obtained from National Census Bureau (www.census.gov). The 2000 Florida WnH population was chosen as the standard population. We identified the number of vascular procedures and calculated rates for the following age groups of Hispanics and WnH of both sexes: <15, 14 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 84, and >85 years. The age and gender adjusted rates were calculated by applying the age-specific and gender-specific rates to the standard population and dividing by the total in the standard population. By this type of adjustment, we removed possible confounding caused by age and gender variation. Rates adjusted for age and gender were presented as the number of vascular procedures per 10,000 standard population.

Statistical analysis. Statistical analysis was performed using SAS software (SAS Institute Inc, Cary, NC). Means were compared with the Student *t* test, and proportions were analyzed using the χ^2 test. Statistical significance was expressed as *P* values and 95% confidence intervals (CIs). CIs for proportions were calculated using normal approximation to the binomial distribution. Multivariate logistic regression analysis was used to analyze risk factors for severity of disease at presentation and outcomes after intervention. The variables analyzed are summarized in Table II. Results of the multivariate logistic regression are presented as odds ratios (ORs) with the appropriate 95% CIs.

RESULTS

Rates of utilization. Utilization of vascular procedures differed substantially between Hispanics and WnH during the period from 2000 to 2004 (Fig 1). Hispanics underwent significantly fewer LER procedures, AAA repairs, and CR compared with WnHs throughout the 5 years analyzed. In contrast, major lower extremity amputations were more common among Hispanics than WnHs. The magnitude of difference in rates of intervention between Hispanics and WnHs was most dramatic for AAA repair and CR, where WnHs had approximately three times as many CR and AAA repairs than did Hispanics.

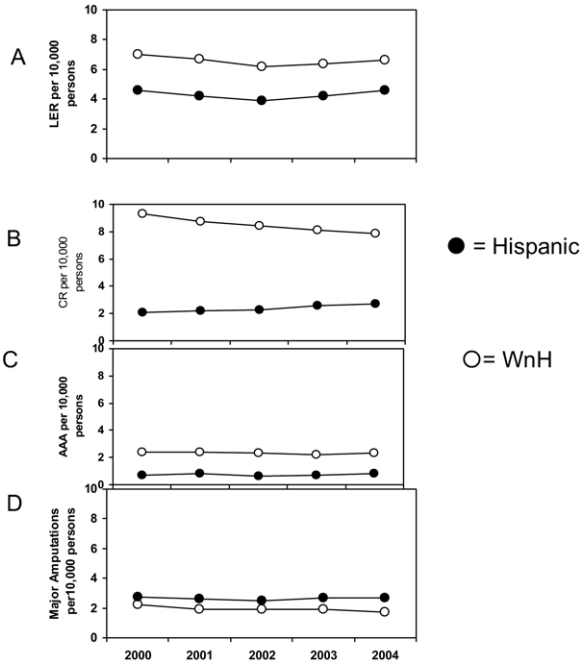

Fig 1. Rate of utilization of vascular procedures for Hispanics *(filled circles)* and white non-Hispanics *(WnH, clear circles)*, 2000-2004. **A,** Lower extremity revascularization *(LER)*. **B,** Carotid revascularization *(CR)*. **C,** Abdominal aortic aneurysm *(AAA)*. **D,** Major lower extremity amputation.

Characteristics of patient populations. Hispanic patients were significantly younger than WnHs, with the largest difference seen among LER patients (2.6 years on average; Table III). The relative proportion of women and men in both groups was similar in LER and CR patients, whereas there were more men among Hispanic AAA patients and amputees. To gain further insight into the cause of the different utilization of vascular procedures, we analyzed the comorbidities affecting these patients. Consistent with a body of evidence indicating a high prevalence of diabetes mellitus type 2 in the Hispanic population, our data show a higher proportion of Hispanic patients had diabetes compared with WnHs for

Table III. Age and sex in Hispanic and white non-Hispanic vascular patients

	No. of observations		*Age (mean)*			*Sex (% of women)*		
Procedure	*WnH*	*H*	*WnH*	*H*	P	*WnH*	*H*	P
LER	66,633	5565	70.4	67.8	<.0001	41.9	42.7	.3177
CR	85,038	3072	71.7	70.2	<.0001	41.7	40.1	.0775
AAA (elective)	22,789	866	73.1	71.6	<.0001	19.9	15.8	.0031
Major amputation	19,626	3260	71.3	69.1	<.0001	44.5	40.6	<.0001

WnH, White non-Hispanic; *H,* Hispanic; *LER,* lower extremity revascularization; *CR,* carotid revascularization; *AAA,* elective abdominal aortic aneurysm.

Table IV. Clinical manifestation of disease at the time of treatment

	Patients receiving procedure (%)			
Indication for procedure	*WnH*	*H*	*P*	*OR (95% CI) for H vs WnH*
Limb threatening ischemia	62.2	80.9	<.0001	2.09 (1.91-2.29)
Symptomatic carotid disease	7.9	11.8	<.0001	1.57 (1.40-1.75)
RAAA	11.0	13.5	.0179	1.26 (1.04-1.52)

OR, Odds ratio; *CI,* confidence interval; *H,* Hispanic; *WnH,* white non-Hispanic; *RAAA,* ruptured abdominal aortic aneurysm.
Number of observations: lower extremity revascularization—WnH, 43,904; Hispanics, 3727; carotid revascularization—WnH, 85,038; Hispanics, 3072; all aortic abdominal aneurysm repairs—WnH, 25,632; Hispanics, 1004.

all procedures analyzed (Table II). Diabetes was more prevalent among Hispanic patients undergoing LER (60.3%) and CR (41.7%) than among Hispanic patients undergoing AAA repairs. In fact, these patients had less diabetes (17.4%) than what has been reported for the general Hispanic population aged 40 to 74 years. Hypertension and renal disease also affected more patients among Hispanics than among WnHs across all procedures analyzed (Table II). WnHs undergoing LER showed an increased prevalence of emphysema, coronary, cerebral, and lipid metabolism complications than did Hispanics; however, with the exception of emphysema, these differences were not noted in patients receiving CR or AAA repairs.

Status of disease progression at time of treatment. We analyzed potential differences in symptoms at the time of treatment between WnHs and Hispanics. Hispanics were significantly more likely to present with limb-threatening ischemia, symptomatic carotid artery disease, and ruptured AAA than WnHs independent of age, gender, and other comorbidities (Table IV). Because of the high prevalence of diabetes in Hispanics, we specifically analyzed the relationship between diabetes and disease status of patients undergoing lower extremity revascularizations. As expected, diabetes was associated with a higher rate of a limb-threatening condition, including rest pain, ulceration, or gangrene, and less so with claudication (Fig 2). When Hispanics and WnHs in the diabetic and nondiabetic cohorts were compared, however, more Hispanics presented with limb-threatening symptoms than did WnHs in both groups. Thus, although Hispanics undergo significantly fewer interventions for common arterial pathologies, they are more likely than WnHs to present with advanced disease.

Outcomes after intervention. We asked if vascular procedures in Hispanic and WnH patients resulted in different outcomes. Our data source limited the analysis to outcomes occurring during the hospital admission for the index treatment. Consistent with the more severe symptom profile, our findings indicate that Hispanic patients had significantly higher rates of major amputation after LER and deaths after elective AAA repair (Table V). No significant differences were found in postoperative stroke for patients undergoing CR. We also found that for all procedures the hospital, length of stay was longer for Hispanics than for WnHs, although for AAA this difference was less dramatic (Table VI).

DISCUSSION

In this study we report major differences between Hispanics and WnHs in the treatment and outcomes of major vascular procedures. Evidence that ethnicity and race are predictors of screening disparities, treatment variations, and health outcomes has been reported in the medical and surgical literature.[17-22] Racial differences in the utilization of surgical procedures have been seen in joint replacements, myocardial revascularization, renal transplant, and even dialysis access, with minorities more likely than whites to have prosthetic arteriovenous grafts vs primary fistulas.[17-19] For lower extremity amputations,[10,11,23-25] numerous publications have shown that race-related differences exist in presentation and rates of intervention. These differences are often attributed to genetic variations, lack of screening, inferior access to care and awareness, delayed intervention, and treatment discrepancies.

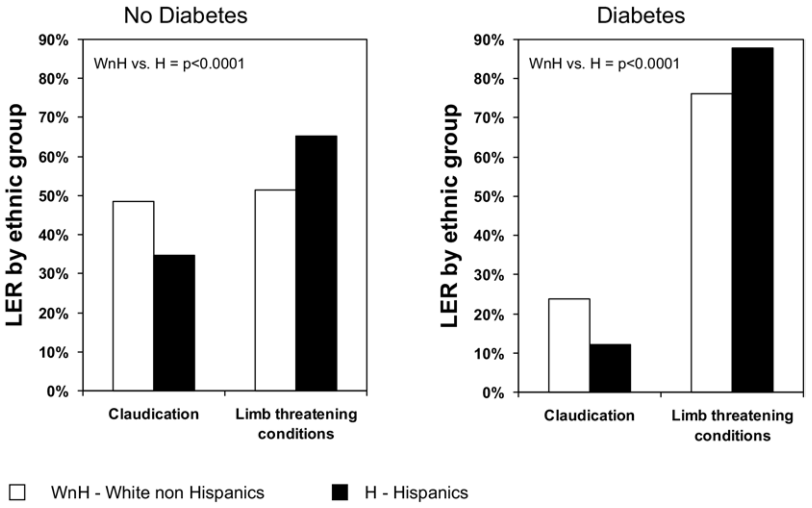

Fig 2. Disease status of Hispanic *(filled bars)* and white non-Hispanic *(WnH, clear bars)* patients undergoing lower extremity revascularization *(LER)* in diabetic and non-diabetic cohort.

Table V. Major outcomes within the same hospitalization after lower extremity revascularization, abdominal aortic aneurysm and carotid revascularization procedures in Hispanics and white non-Hispanics*

	Patients receiving the procedure, %			
Major outcome	*WnH*	*H*	P	*OR (95%CI) for H vs WnH*
Amputations after LER	3.4	6.2	<.00011	.67 (1.48-1.88)
Deaths after elective AAA	3.4	5	.00321	.63 (1.18-2.27)
Stroke after CR	1.2	1.3	.47351	.12 (0.82-1.54)

WnH, White non-Hispanic; *H,* Hispanic; *OR,* odds ratio; *CI,* confidence interval; *LER,* lower extremity revascularization; *AAA,* abdominal aortic aneurysm; *CR,* carotid revascularization.
*See Table III for number of observations.

Table VI. Length of stay of vascular patients receiving lower extremity revascularization, carotid revascularization, and abdominal aortic aneurysm repair*

Procedure	*WnH*	*H*	*P*
LER			
Mean	8	12.3	<.0001
Median	5	8	
CR			
Mean	2.9	4.9	<.0001
Median	2	2	
AAA (elective)			
Mean	7.5	8.6	.003
Median	6	6	

WnH, White non-Hispanic; *H,* Hispanic; *LER,* lower extremity revascularization; *CR,* carotid revascularization; *AAA,* elective abdominal aortic aneurysm.
*See Table III for number of observations.

A recent study by Jha et al,[26] found that racial differences in the rate of utilization of major therapeutic procedures did lessen significantly during the 1990s. Our study detected significant differences in the rates of treatment of AAA, carotid artery disease, and lower extremity arterial disease between Hispanic and WnH patients. Having noted these disparities, attempts at explaining them and reducing them represent the critically important aspect of this project.

Previous studies have shown an increased prevalence of diabetes and renal insufficiency in Hispanics.[7,8] Consistent with these reports, we observed significantly higher rates of diabetes and renal insufficiency in Hispanics undergoing LER, AAA repair, and CR (Table II). A possible confounding factor may be that diabetes is less well controlled in Hispanics and therefore more severe sequelae may be expected. This would explain why diabetes alone did not fully explain disparities we have identified but could still be responsible for a significant portion of the results we demonstrated. Higher rates of diabetes may be related to biologic tendency or dietary and socioeconomic factors.

Our data also showed a higher rate of hypertension, a known risk factor for vascular disease, among Hispanics (Table II). The Northern Manhattan Stroke Study demonstrated an increased prevalence within the Hispanic population of untreated and unrecognized hypertension.[27,28] Therefore, efforts directed at detection and

control of diabetes and hypertension would be an important component of a strategy aimed at addressing vascular disease in Hispanics.

Socioeconomic factors may affect patients' access to proper preventive and diagnostic care. One survey describes Hispanics to have the highest reported uninsured rate among all ethnic groups and to lack basic access to medical care largely due to poor communication and understanding between patient and physician.[29] We believe insurance status may result in inferior access to preventive and diagnostic care in Hispanic patients, thus resulting in more advanced disease at the time of treatment. Cigarette smoking, a well-known risk factor for vascular disease, is lower among Hispanics than WnHs.[30,31] Although we have not specifically analyzed this risk factor in our study, the lower rate among Hispanics makes this factor less likely to be a confounding variable in our analysis. Indeed, lower rates of tobacco abuse among Hispanics make our results appear more dramatic with respect to ethnicity as a risk factor for vascular disease.

With respect to lower extremity arterial disease, our data indicate that Hispanic patients present with more advanced limb ischemia and have higher rates of failed LER and major amputation than WnHs (Fig 2, Tables IV and V). Conversely, WnHs are more often treated for claudication as the indication for LER.

With strong evidence demonstrating that Hispanics have a higher prevalence of risk factors and comorbidities well known to promote peripheral vascular disease, it may seem appropriate to attribute the disparities discovered in this analysis to modifiable and treatable risk factors. However, Hispanic ethnicity remained associated with more advanced disease even after controlling for coexisting comorbidities, including diabetes. Certain socioeconomic factors such as lower level of education, lack of insurance, and low income are more prevalent in ethnic minorities and can potentially have a negative effect on health outcomes.[32-36] Moreover, many Hispanics traditionally rely on generations of self-care methods and are reluctant to seek professional treatment and may even be less "willing" to consider prophylactic surgical interventions.[37-39] As a result, peripheral vascular disease may progress to later stages before treatment is sought. It is also possible that there are genetic differences in the nature and manifestation of vascular disease in Hispanics.

Our analysis shows that Hispanics have lower rates of carotid intervention and presented more often with symptomatic carotid disease, whereas WnHs are more likely asymptomatic at the time of diagnosis (Table IV). The reasons for an overall lower rate of carotid intervention in Hispanics are unclear but may include a tendency toward less plaque formation,[40] which may result in less extracranial disease. However, a higher incidence of ischemic strokes of all etiologies has been previously reported in Hispanics.[41]

Our consistent finding of advanced symptomatology at presentation among Hispanics may be partially due to lower rates of screening for asymptomatic carotid disease. This result suggests that proper access to screening and prophylactic intervention may significantly reduce strokes in this population by allowing treatment of asymptomatic patients. The paradox of lower intervention rates but more advanced disease at time of treatment suggests that a significant proportion of patients are not detected when prophylactic treatment is most effective.

We have demonstrated that Hispanics undergo elective AAA repair much less frequently than WnHs. The reasons for this finding are unclear, and published reports addressing AAA in Hispanics are scarce. Diabetes has been suggested as a negative predictor of AAA.[42] An interesting observation was a low rate of diabetes when AAA repair was compared with LER and carotid intervention, a finding that supports a possible negative association between these two entities (Table II). The higher rate of diabetes among Hispanics may result in lower rates of AAA and in part explain our observation of fewer AAA repairs in this group. However, less access to screening may also lead to lower detection of AAA and hence fewer elective repairs.

Although Hispanics had significantly lower rates of AAA repair, they were more likely to present with rupture (Table IV). It is possible that Hispanics are less likely to be diagnosed and treated before the AAA requires urgent repair. Differences in disease presentation and rates of disease progression are also a possible explanation. The significant increase in the outcome of death after elective AAA repair for Hispanic may be partially attributed to the higher prevalence of renal failure in the Hispanic population studied compared with WnHs (Tables II and V).[43-46]

Administrative databases are quite powerful because of the amount of data they contain, but they have certain inherent limitations. This analysis relies on the assumption that ethnicity is reported accurately in the discharge data. Errors in coding of comorbidities, risk factors, and assignment of ethnicity are possible. The effects of such limitations are possibly diminished by the "randomization" of nonsystematic errors that results when massive numbers of observations are statistically analyzed.[47] In addition, the population defined as Hispanic by statewide databases is heterogeneous in many ways. Our results may not fully reflect the diverse experience of this population and may neglect important differences within this group. Nonetheless, important common cultural and socioeconomic factors support the use of this broad definition.

CONCLUSION

Hispanic patients underwent significantly fewer procedures for AAA and carotid artery disease than did white non-Hispanics but tended to present with more advanced disease at the time of treatment. Lower extremity revascularization procedures were more likely to be for

limb-threatening ischemia in Hispanics than white non-Hispanics and were more likely to result in amputation. The reasons for such disparities are likely to be multifactorial and require further investigation.

AUTHOR CONTRIBUTIONS

Conception and design: NM, KK, AG, GG, JG
Analysis and interpretation: NM, GG, AG, NE, JG
Data collection: NM, GG, JG, NE
Writing the article: NM, GG, NE, JG, KK, AG, AM
Critical revision of the article: NM, KK, NE, JG, GG, AG, AM
Final approval of the article: NM, KK, AG, AM, GG
Statistical analysis: NE, NM, AG, JG, GG
Obtained funding: Not applicable
Overall responsibility: NM

REFERENCES

1. U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin. Available at: http://www.census.gov/ipc/www/usinterimproj/natprojtab01a.pdf. Accessed Sept 28, 2006.
2. Anonymous. Diverse Hispanic population to become largest U.S. minority. Popul Today 1997;25:1-2.
3. Wong MD, Tagawa T, Hsieh HJ, Shapiro MF, Boscardin WJ, Ettner SL. Differences in cause-specific mortality between Latino and white adults. Med Care 2005;43:1058-62.
4. Reddy J, Son H, Smith SJ, Paultre F, Mosca L. Prevalence of breast arterial calcifications in an ethnically diverse population of women. Ann Epidemiol 2005;15:344-50.
5. Peralta CA, Shlipak MG, Fan D, Ordoñez J, Lash JP, Chertow GM, et al. Risks for end-stage renal disease, cardiovascular events, and death in Hispanic versus non-Hispanic white adults with chronic kidney disease. J Am Soc Nephrol 2006;17:2892-9.
6. Borrell LN, Dallo FJ, White K. Education and diabetes in a racially and ethnically diverse population. Am J Public Health 2006;96:1637-42.
7. Benabe JE, Rios EV. Kidney disease in the Hispanic population: facing the growing challenge. J Natl Med Assoc 2004;96:789-98.
8. Incidence & Prevalance Racial Differences in the Incidence of ESRD. 2006 Annual Data Report. Available at: http://www.usrds.org/2006/pdf/02_incid_prev_06.pdf. Accessed Oct 24, 2006.
9. Wetrogan SI. Projections of the population of states, by age, sex, and race: 1988 to 2010. Curr Popul Rep Popul Estim Proj 1988:1-124.
10. Rucker-Whitaker C, Feinglass J, Pearce WH. Explaining racial variation in lower extremity amputation: a 5-year retrospective claims data and medical record review at an urban teaching hospital. Arch Surg 2003;138:1347-51.
11. Feinglass J, Rucker-Whitaker C, Lindquist L, McCarthy WJ, Pearce WH. Racial differences in primary and repeat lower extremity amputation: results from a multihospital study. J Vasc Surg 2005;41:823-9.
12. New York State Department of Health Statewide Planning and Research Cooperative System (SPARCS). Annual reports. Available at: http://www.health.state.ny.us/nysdoh/sparcs/sparcs.htm#general.
13. Florida Health Stat. Available at: http://www.floridahealthstat.com.
14. Nowygrod R, Egorova N, Greco G, Anderson P, Gelijns A, Moskowitz A, et al. Trends, complications, and mortality in peripheral vascular surgery. J Vasc Surg 2006;43:205-16.
15. Greco G, Egorova N, Anderson PL, Gelijns A, Moskowitz A, Nowygrod R, et al. Outcomes of endovascular treatment of ruptured abdominal aortic aneurysms. J Vasc Surg 2006;43:453-9.
16. Colton T. Statistics in medicine. Boston, MA: Little, Brown & Company; 1974.
17. Reddan DN, Szczech LA, Klassen PS, Owen WF Jr. Racial inequity in America's ESRD program. Semin Dial 2000;13:399-403.
18. Ramsey DJ, Goff DC, Wear ML, Labarthe DR, Nichaman MZ. Sex and ethnic differences in use of myocardial revascularization procedures in Mexican Americans and non-Hispanic whites: the Corpus Christi Heart Project. J Clin Epidemiol 1997;50:603-9.
19. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Understanding ethnic differences in the utilization of joint replacement for osteoarthritis: the role of patient-level factors. Med Care 2002;40(1 Suppl):I44-51.
20. Giacomini MK. Gender and ethnic differences in hospital-based procedure utilization in California. Arch Intern Med 1996;156:1217-24.
21. Andrews RM, Elixhauser A. Use of major therapeutic procedures: are Hispanics treated differently than non-Hispanic Whites. Ethn Dis 2000;10:384-94.
22. Disparities in screening for and awareness of high blood cholesterol–United States, 1999-2002. MMWR Morb Mortal Wkly Rep 2005;54:117-9.
23. Lavery LA, Ashry HR, van Houtum W, Pugh JA, Harkless LB, Basu S. Variation in the incidence and proportion of diabetes-related amputations in minorities. Diabetes Care 1996;19:48-52.
24. Collins TC, Johnson M, Henderson W, Khuri SF, Daley J. Lower extremity nontraumatic amputation among veterans with peripheral arterial disease: is race an independent factor? Med Care 2002;40(1 Suppl):I106-116.
25. Chew DK, Nguyen LL, Owens CD, Conte MS, Whittemore AD, Gravereaux EC, et al. Comparative analysis of autogenous infrainguinal bypass grafts in African Americans and Caucasians: the association of race with graft function and limb salvage. J Vasc Surg 2005;42:695-701.
26. Jha AK, Fisher ES, Li Z, Orav EJ, Epstein AM. Racial trends in the use of major procedures among the elderly. N Engl J Med 2005;353:683-91.
27. Sacco RL, Kargman DE, Zamanillo MC. Race-ethnic differences in stroke risk factors among hospitalized patients with cerebral infarction: the Northern Manhattan Stroke Study. Neurology 1995;45:659-63.
28. Sacco RL, Boden-Albala B, Abel G, Lin IF, Elkind M, Hauser WA, et al. Race-ethnic disparities in the impact of stroke risk factors: the northern Manhattan stroke study. Stroke 2001;32:1725-31.
29. Doty M. Quality of health care for Hispanic populations. The Commonwealth Fund Available at: www.cmwf.org.
30. Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review Ethn Dis. 2007;17:143-52.
31. Centers for Disease Control and Prevention (CDC). Prevalence of cigarette use among 14 racial/ethnic populations-United States, 1999-2001. MMWR Morb Mortal Weekly Report. 2004;53:49-52.
32. Westberg J. Patient education for Hispanic Americans. Patient Educ Couns 1989;13:143-60.
33. Wachtel MS. Family poverty accounts for differences in lower-extremity amputation rates of minorities 50 years old or more with diabetes. J Natl Med Assoc 2005;97:334-8.
34. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. Circulation 1993;88:1973-98.
35. Berk ML, Albers LA, Schur CL. The growth in the US uninsured population: trends in Hispanic subgroups, 1977 to 1992. Am J Public Health 1996;86:572-6.
36. Hispanic health in the United States. Council on Scientific Affairs. JAMA 1991;265:248-52.
37. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Differences in expectations of outcome mediate African American/white patient differences in "willingness" to consider joint replacement. Arthritis Rheum 2002;46:2429-35.
38. Gonzalez-Swafford MJ, Gutierrez MG. Ethno-medical beliefs and practices of Mexican-Americans. Nurse Pract 1983;8:29-30,32,34.
39. da Silva GC. Awareness of Hispanic cultural issues in the health care setting. Child Health Care 1984;13:4-10.
40. Sacco RL, Roberts JK, Boden-Albala B, Gu Q, Lin IF, Kargman DE, et al. Race-ethnicity and determinants of carotid atherosclerosis in a multiethnic population. The Northern Manhattan Stroke Study. Stroke 1997;28:929-35.
41. White H, Boden-Albala B, Wang C, Elkind MS, Rundek T, Wright CB, et al. Ischemic stroke subtype incidence among whites, blacks, and Hispanics: the Northern Manhattan Study. Circulation. Mar 15 2005;111:1327-31.

42. Lederle FA, Johnson GR, Wilson SE, Chute EP, Littooy FN, Bandyk D, et al. Prevalence and associations of abdominal aortic aneurysm detected through screening. Aneurysm Detection and Management (ADAM) Veterans Affairs Cooperative Study Group. Ann Intern Med 1997;126:441-9.
43. Steyerberg EW, Kievit J, de Mol Van Otterloo JC, van Bockel JH, Eijkemans MJ, Habbema JD. Perioperative mortality of elective abdominal aortic aneurysm surgery. A clinical prediction rule based on literature and individual patient data. Arch Intern Med 1995;155: 1998-2004.
44. Huber TS, Wang JG, Derrow AE, Dame DA, Ozaki CK, Zelenock GB, et al. Experience in the United States with intact abdominal aortic aneurysm repair. J Vasc Surg 2001;33:304-10; discussion 310-1.
45. Hua HT, Cambria RP, Chuang SK, Stoner MC, Kwolek CJ, Rowell KS, et al. Early outcomes of endovascular versus open abdominal aortic aneurysm repair in the National Surgical Quality Improvement Program-Private Sector (NSQIP-PS). J Vasc Surg 2005;41:382-9.
46. Becquemin JP, Chemla E, Chatellier G, Allaire E, Melliere D, Desgranges P. Peroperative factors influencing the outcome of elective abdominal aorta aneurysm repair. Eur J Vasc Endovasc Surg 2000;20:84-9.
47. Lee WA, Carter JW, Upchurch G, Seeger JM, Huber TS. Perioperative outcomes after open and endovascular repair of intact abdominal aortic aneurysms in the United States during 2001. J Vasc Surg 2004;39:491-6.

Submitted Feb 17, 2007; accepted Jul 5, 2007.